PSYCHE

Vol. 59 June, 1952 No. 2

INHERITANCE OF SOME VARIETAL CHARACTERS IN *CHRYSOPA OCULATA* SAY (NEUROPTERA: CHRYSOPIDAE)*

By William E. Bickley
College Park, Maryland

Varieties of *Chrysopa oculata* Say are distinguished by the degree of darkness of wing veins and by color patterns, chiefly markings on the genae, vertex, and pronotum. Most of the varieties are species synonyms. *C. albicornis* Fitch, which has dark cross veins, and *C. chlorophana* Burm., which has green cross veins, were placed under *C. oculata* Say by Smith (1922). One of several reasons for doing so was the fact that the forms readily cross.

Smith (1932 and 1934) recognized five varieties which have different color patterns on the vertex. In *carei* Smith, spots on the vertex are absent. In *xanthocephala* Fitch there are two black or brown spots in the antennal band or closely connected with it; but if the two spots are not connected with the antennal band the form is called *bipunctata* Fitch. Variety *oculata* Say has four dark spots on the vertex (pl. 5, A). In *illepida* Fitch there are two elongate bands; in other words the spots on each side are fused (pl. 5, B).

When large numbers of *Chrysopa oculata* are examined it is found that some specimens cannot be placed in the recognized categories. A good example is a form in which the vertex has two spots on one side and an elongate band on the other (pl. 5, C). In an attempt to clarify the status of some of the varieties, an investigation was made of the inheritance of some characters upon which varieties are based.

* Scientific Art. No. A357, Contribution No. 2338 of the Maryland Agricultural Experiment Station, Department of Entomology. Dr. Sumner O. Burhoe, Professor of Zoology, University of Maryland aided in interpreting the possible genetic status of the varieties.

Field-collected gravid females were put in separate fruit jars with cheese-cloth coverings, and eggs obtained from them were isolated in one-ounce bottles with absorbent cotton plugs. Larvae were given about a dozen field-collected aphids every day or every other day. Sometimes larvae were fed termite workers. They spun cocoons, pupated, and emerged in the small bottles. Adults lived and reproduced satisfactorily in fruit jars. They were given a few aphids and a little water daily. The average duration of the egg stage was approximately three days and the larval stage, 14 days. Adults usually emerged 14 days after the cocoon was spun.

Two varieties were reared, inbred and inter-bred, namely the common *oculata,* which has four spots on the vertex, and *illepida,* which has two elongate bands on the vertex. Seven *oculata* females of unknown ancestry, some from different localities in Maryland, produced 103 offspring. Of these, 101 or 98% were *oculata.* There were one *illepida* and one *xanthocephala* (a form with only two spots). The progeny of two wild *illepida* females consisted of 83 individuals, 58 of which were *oculata* and 25 of which were *illepida*—respectively 70% and 30%.

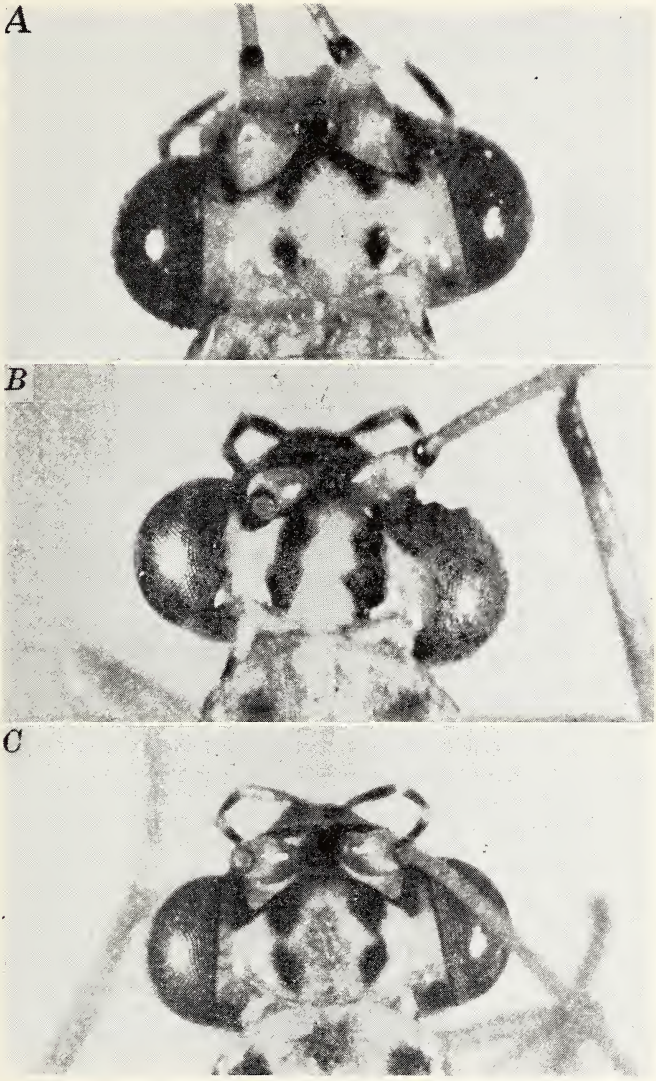
Twelve pairs of first generation individuals were mated so that offspring of nearly all possible combinations could be studied. To determine whether or not there was any sex linkage, duplicate crosses were made in which the sexes with given characters were reversed.

Results of second generation pairings are given in Table 1. It is obvious that the genes responsible for *oculata* are more prevalent. This appears to be true not only in the populations reared but also throughout the range of the species. It is unlikely, however, that *oculata* is a dominant character in the Mendelian sense, because of its occurrence in offspring from *illepida* parents. Pairing F as given in the table shows that one pair of *illepida* from an *illepida* female produced 50% *oculata* offspring, indicating that they carried the *oculata* gene. This high percentage fur-

---

Explanation of Plate 4

Markings on the vertex of *Chrysopa oculata.* A. Variety *oculata.* B. Variety *illepida.*. C. "Borderline" individual.



BICKLEY—INHERITANCE IN CHRYSOPA

nishes proof that *oculata* is not a simple dominant. Furthermore, in B, C, and E *oculata*, presumably heterozygous if *illepida* is recessive (because they were the offspring of *illepida* females) produced low percentages of *illepida*. If *oculata* were dominant the expected proportions of *illepida* would be 25% in B and C, and 50% in E.

The high percentage of *oculata* offspring in all the crosses occurs in a manner showing close approximation to the results expected from segregating recessives with a rare production of *illepida*, which could be explained by the presence of two or more pairs of recessive genes either of which in the homozygous recessive state could produce *oculata*. Thus, if there are two genes any one of which in the recessive state would produce *oculata*, a cross like those in D (Table 1) could theoretically produce 25% *illepida*, provided that the *illepida* parent is heterozygous for both pairs of genes. The actual number obtained was 19%. If it is assumed that any one of three genes in the recessive state might produce *oculata*, the actual ratios of the five crosses will conform more closely with the theoretical.

Whatever the genetic mechanism may be, it can be concluded that *illepida* is not a simple recessive. If such were the case, inbreeding could not possibly produce anything except *illepida*, but actually the result is 50% *oculata*. (Table 1, F.) Conversely, the fact that inbreeding of five pairs of *oculata* from an *oculata* female gives only *oculata* suggests that this character may be a recessive. There are of course the other patterns on the vertex to be considered, but no attempt is being made to explain their occurrence.

Even though the manner in which the variations are produced cannot be explained easily and regardless of the percentages of the two varieties obtained from the different crosses, the important point is that the characters which have caused the naming of *oculata* and *illepida* are inherited. Moreover this appears to be true for the other varieties previously mentioned, including those with differences in darkness of wing venation.

An eighth variety recognized by Smith (1932) is *separata* Banks which "is distinguished by the absence of a connection between the black loop under the antennae and the black genal band." If the connection is very faint the

form is still called *separata*. There are various degrees in reduction of width of this connecting band, and in this case it appears that the character is so subtle that it is not reliable.

Because of inconsistencies and intergradations in color patterns and because the genetic status of some of the varietal characters is at least partially understood, it seems reasonable to conclude that the varietal names are no longer of any value. The avoidance of the term variety where it lacks real meaning is one of the principles set forth by Ferris (1928). If this principle is applied the work of the taxonomist will be simplified. He no longer has a problem when he is confronted with borderline cases such as individuals with spots on one side of the vertex and a band on the other, and specimens with the face as in *separata*, the vertex as in *illepida*, and the wings as in *albicornis*.

	Pairing	No. of Pairs	Total Off-Spring	*oculata* No.	*oculata* %	*illepida* No.	*illepida* %	Borderline No.	Borderline %
A	oc(oc) x oc(oc)	5	84	84	100				
B	oc(oc) x oc(ill)	2	83	78	94	4	5	1	1
C	oc(ill) x oc(ill)	1	11	10	91	1	9		
D	oc(oc) x ill(ill)	2	59	48	81	11	19		
E	oc(ill) x ill(ill)	1	60	39	65	21	35		
F	ill(ill) x ill(ill)	1	18	9	50	8	44	1	6

Table 1. Inbreeding and crossing of two varieties of *Chrysopa oculata* (Say); oc(oc) indicates *oculata* from an *oculata* female; oc(ill) indicates *oculata* from an *illepida* female; ill(ill) indicates *illepida* from an *illepida* female.

Summary

Two varieties of *Chrysopa oculata* Say were reared, inbred, and interbred, namely, the common *oculata*, which has four spots on the vertex, and *illepida*, which has two elongate bands on the vertex. Twelve second generation pairings were made and 315 offspring obtained. All of these pairings resulted in high percentages of *oculata*. It is, therefore, concluded that the genes responsible for this character are more prevalent. However, *oculata* is not a

simple dominant, and there is evidence which suggests that there are two or more genes, any one of which in the recessive state produces *oculata*. Because of inconsistencies and intergradations in color patterns and because the genetic status of some of the varietal characters is partially understood, it may be concluded that the varietal names are no longer of any value.

Literature Cited

Ferris, G. F.

1928. The principles of systematic entomology. Stanford Univ. Publications. Univ. Series. Biol. Sci., 5 (3):103-268.

Smith, R. C.

1922. The biology of the Chrysopidae. Cornell Univ. Agr. Exp. Sta. Memoir 58:1291-1372.

1932. The Chrysopidae (Neuroptera) of Canada. Ann. Ent. Soc. Amer., 25:579-601.